INFLUENCE OF WATER STRESS AND *MACROPHOMINA PHASEOLINA* IN GROWTH AND GRAIN YIELD OF COMMON BEANS UNDER CONTROLLED AND FIELD CONDITIONS

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Drought stress reduces common bean (*Phaseolus vulgaris* L.) grown and grain yield as well as increases susceptibility to root rot pathogens such as *Macrophomina phaseolina* (Tassi) Goid (Mp) (2, 3). Under controlled conditions water stress rather than Mp affects growth, water relations and grain yield of common beans (2) and resistant cultivars show xeromorphic traits compared with susceptible germplasm (3). Some efforts have been conducted to identify RAPD (6) and QTLs (5) associated to Mp resistance but not to combined resistances. The aim of this work was to compare the response to combined Mp and water stress under both controlled and field conditions of two contrasting common bean cultivars.

Two experiments were conducted during 2008, one under controlled (Reynosa, México; 26° 05' N, 98° 18' W, 38 masl) and the other in field conditions (Rio Bravo, México, 25° 59' N, 98° 06' W, 39 masl). In both them, two bean cultivars (BAT 477, resistant to Mp and water stress and Pinto UI-114, susceptible) (4); two humidity (irrigation through biological cycle and terminal water-stress where irrigation was stopped when flowering started until five days under PWP in greenhouse and until harvest in field experiment) and two inoculation levels (inoculated with rice seeds colonized by a highly virulent isolate of Mp at 5% w/w ratio for greenhouse test and 5 g m^{-1} row in field). Experimental unit was one 20 L pot with three plants (greenhouse) and 2 rows 5 m-length where 100 seeds were sown (field). Treatments (cultivars x humidity levels x inoculation levels) were randomized in RC and RCB designs under controlled (four replications by treatment) and field (three replications) conditions, respectively. In both experiments RWC, charcoal rot severity, dry biomass and grain yield were measured. Data were subjected to ANOVA and means were compared using Tukey test (P=0.05).

Under both controlled and field conditions, water stress and *M. phaseolina* reduced RWC at first and fifth day in PWP (Fig. 1) as well as dry biomass accumulation in vegetative organs and grain yield at harvest, although greatest negative effects was caused by water stress particularly in Pinto UI-114 (2, 3). On the other hand, *M. phaseolina* inoculation favored infection and development of charcoal rot disease in Pinto UI-114 and this effect was aggravated by drought stress (Table 1). Our results indicated that BAT 477 is resistant to both water stress and charcoal rot disease based on water relations as RWC, dry biomass accumulation in the different plant organs and grain yield. In addition, water stress aggravates negative effects by charcoal rot in common bean susceptible germplasm (2, 3). Our current efforts are focused to mapping QTLs associated to both charcoal rot and water stress resistances in BAT 477 and then try to develop molecular markers for MAS (1).

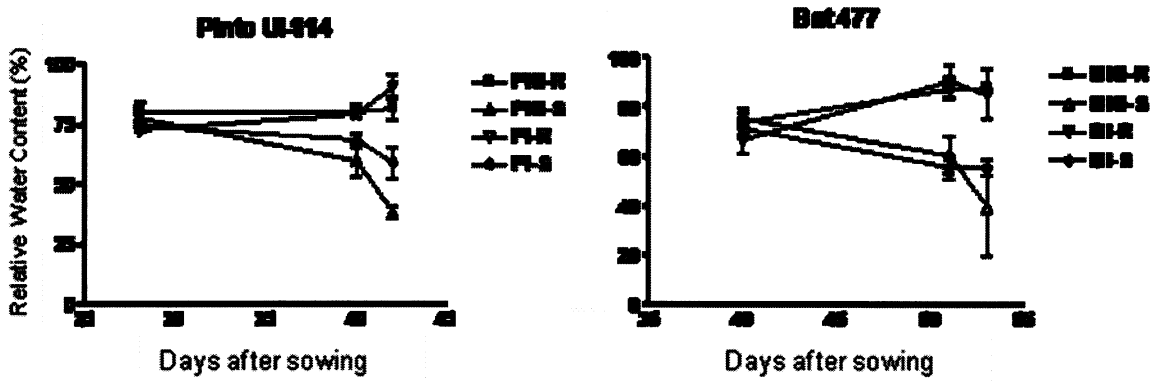

Fig. 1. Relative water content in two bean cultivars growing under two humidity and two *M. phaseolina* inoculation levels under controlled conditions (NI=no inoculated, I=inoculated; R=Irrigated, S=Water-stressed).

Table 1. Charcoal rot severity and dry biomass in two bean cultivars growing under two humidity and two *M. phaseolina* inoculation levels under controlled conditions under controlled and field conditions.

Treatment	Greenhouse				Field			
	SEV[1]	PDB (g)	GY (g)	HI (%)	SEV	PDB (g)	GY (g)	HI (%)
Pinto UI-114								
Irrigated-Inoculated	8.2	6.6	2.7	41	4.3	0.9	0.2	22
Irrigated-No inoculated	1.0	7.2	5.1	71	5.7	1.1	0.3	27
Drought-Inoculated	6.8	1.0	0.5	50	3.0	0.4	0.1	25
Drought-No inoculated	1.0	2.2	0.5	23	3.3	0.4	0.2	50
BAT 477								
Irrigated-Inoculated	5.3	11.0	1.7	15	2.7	3.1	0.6	19
Irrigated-No inoculated	1.0	11.0	1.8	16	3.3	1.4	0.5	36
Drought-Inoculated	6.0	5.2	0.4	9	5.7	1.7	0.2	12
Drought-No inoculated	1.0	3.6	0.6	17	6.3	1.5	0.2	13
HLSD (P=0.05)	1.2	3.5	0.8	25	1.6	0.4	0.2	21

[1]SEV=charcoal rot severity at fifth PWP day; PDB=plant dry biomass; GY=grain yield; HI=harvest index.

REFERENCES

1) Hernandez-Delgado S *et al.* (2009) Journal of Plant Pathology (in press).
2) Mayek-Pérez N *et al.* (2002a) Physiological and Molecular Plant Pathology 60: 185-195.
3) Mayek-Pérez N *et al.* (2002b) *Scientiae Naturae* 4: 33-44.
4) Mayek-Pérez N *et al.* (2004) Agronomía Mesoamericana 15: 45-52.
5) Miklas PN *et al.* (1998) Crop Science 38: 916-921.
6) Olaya G *et al.* (1996) Phytopathology 86: 674-679.